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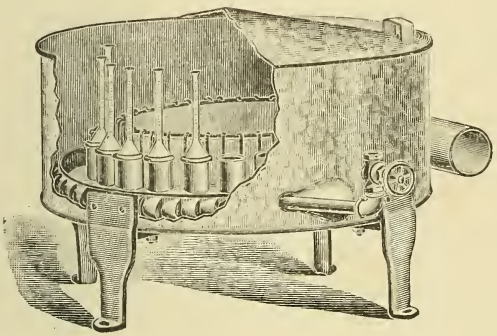

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A MODIFICATION OF THE BABCOCK METHOD AND APPARATUS FOR TESTING MILK AND CREAM.

J. M. Bartlett.

The modifications described in this bulletin, briefly stated, are as follows:

The modification of the method consists chiefly in filling the bottles with hot water after the milk or cream and acid are added, before they are put in the centrifugal machine and whirled. In this way the separation is completed with one whirling and the time required for the second whirling is saved.

The modifications of the apparatus are: The base portions of the milk and cream bottles are graduated so that no acid measure is required and the base portion of the cream bottle is reduced in size.

While working with the Babcock test some months ago it occurred to the writer that separating the fat before adding water, was an unnecessary part of the process if the right conditions could be brought about and that the hot water might be added directly after mixing the acid and milk together. Accordingly, to decide the matter, a series of experiments were conducted, resulting in the adoption of the following method, which has been used successfully for the past six months with all kinds of milk and cream.

Method for Milk.

After the milk is mixed by stirring or pouring from one vessel to another, the required amount, 17.6 cubic centimeters, is measured into the test bottle. It is then heated to about 70 degrees Fahrenheit, if not already at that temperature, by setting the bottles in a tank of warm water. Twenty cubic centimeters of sulphuric acid (specific gravity 1.82 to 1.825) are added and the bottle shaken by giving it a rotary motion until the milk and acid are thoroughly mixed. The mixture is then allowed to stand not less than five minutes. No harm is done if it stands longer than five minutes and in fact, occasionally, some kinds of milk have to be given a little more time. After standing the necessary time the

bottle is given another gentle shake to mix in and dissolve any particles of curd that may have risen to the surface. Hot water is then added nearly to the uppermost mark, the bottle is put in the centrifugal machine and whirled for five minutes at the rate of 1000 to 1200 revolutions per minute. A steam turbine machine is best for this purpose but a hand or belt power machine can be used, if hot water is put in the pan to keep the fat melted. After the whirling is completed the per centage of fat can be read off in the usual manner.

It would appear that the time required for the bottles to stand after the acid is mixed with the milk, would offset that gained by omitting the second whirling which is made in the old method; but the writer has often found it necessary with many kinds of milk, especially with that from cows much advanced in the period of lactation, to allow the bottles to stand a while, even when working the two whirling method, in order to get a clear separation of fat. However, every one who does much testing should have at least two sets of bottles, so there would be no loss of time by this process. When two sets of bottles are at hand one set, charged with the milk and acid, can stand while the second set is being filled, and the second set can stand while the first is being whirled. It is much better to make twelve tests at a time than to make a larger number. Twelve are about all one can easily read off before the fat begins to cool and contract in volume.

For the above described modification of the milk test no change of apparatus need be made, but the writer, however, prefers to have the base portion of the bottle graduated as before mentioned so no acid measure is required and only one pouring of the acid is necessary. By having the bottle marked at the point (*a* Fig. 1) at which mark it holds 37.5 cubic centimeters, one can, after the milk is measured in with the pipette, run the acid in until it is filled to this point. It was found impracticable to use a bottle with a smaller base capacity like the cream bottle described farther on, because of the larger amount of curd in milk than in cream and the small size of the neck of the milk bottle necessitating more space for shaking, breaking up the curd and dissolving it in the acid.

The Cream Bottle.

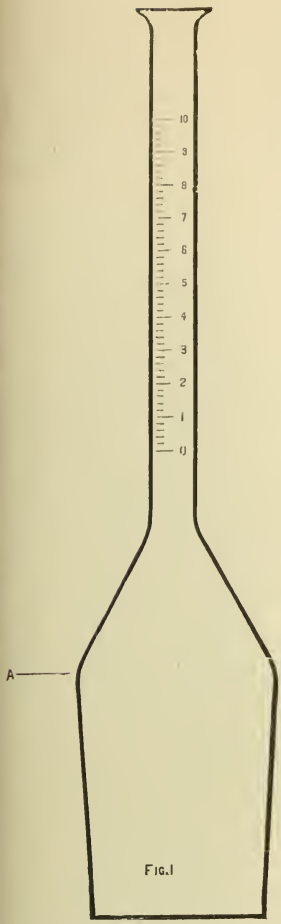

Fig. 1

Fig. 2.

The bottle here described (Fig. 2) is similar to the regular milk bottle, and also to the Connecticut Station cream bottle, except that the base portion is made of such size as to avoid using an acid measure. The base is made to hold about 38 cubic centimeters up to the neck and after the cream is measured in, the required amount of acid can be added by filling the bottle nearly to the neck or to the point *a* shown in the cut. The neck portion is large enough to carry 25 per cent. of fat and is graduated to one-half of one per cent. and can be easily read to one-quarter of one per cent. Each per cent. is numbered. Although one cannot read so closely with this as with the bulb neck bottle (described in Bulletin No. 3, Second Series, Maine Experiment Station), which was designed to test both milk and cream, one can read fine enough for all practical purposes. On account of the neck being larger and shorter, this bottle is more easily cleaned than either of the older forms; it is less liable to breakage, and by using the method previously given for milk a test can be made more rapidly. Twenty-five per cent. was fixed upon as the capacity of the neck for the reason that a much higher percentage necessitates an increase in diameter which impairs the

accuracy in reading and again, nearly all cream shipped to the creameries is raised by the cold deep setting process and seldom contains more than twenty per cent. of fat. If one wishes to test separator cream that is very rich, 9 cubic centimeters or 9 grams of the cream can be taken instead of 18, 9 cubic centimeters of water added and the usual amount of acid. The per-cent. of fat obtained in that case of course should be multiplied by two, to give a correct reading.

Comparison of Results Obtained by Old and New Methods.

Below are given, in tabular form, a few of the many results obtained on milk and cream in comparing the old method with the one whirling method.

Milk.		Milk.		Milk.		Cream.	
Whirled once. %	Whirled twice. %	Whirled once. %	Whirled twice. %	Whirled once. %	Whirled twice. %	Whirled once. %	Whirled twice. %
5.3	5.3	5.2	5.3	3.8	3.7	18¾	18¾
5.6	5.6	5.3	5.4	4.1	4.2	18½	18¾
6.0	6.0	4.7	4.8	5.2	5.0	18¾	18¾
4.9	4.9	5.0	4.9	5.1	5.2	18½	18¾
4.9	5.0	5.8	5.8	5.3	5.1	23½	23¼
5.2	5.2	5.0	5.0	5.0	5.0	23¾	...
4.6	4.6	4.9	4.9	5.0	5.2	17	17¼
5.0	5.1	4.9	5.0	5.7	5.8	19¼	19

Method for Cream.

The method employed for cream is as follows:

Measure 18 cubic centimeters or weigh 18 grams of the thoroughly mixed cream, carrying not more than 25 per cent. of fat, into the bottle. Heat it to about 70° F. if not already at that temperature, then fill the bottle up nearly to the base of the neck (point *a*, fig. 2) with sulphuric acid, specific gravity 1.82. The acid can be handled in a sharp-nosed pitcher or run in from a syphon affixed to a bottle or carboy. Mix the acid and cream together thoroughly, which is best done by grasping the neck with

the hand, pressing the thumb tightly over the opening and then giving the bottle a rotary motion, holding it upright all the time. The confined air prevents the curd from coming up and sticking to the sides of the neck. The mixing is just as easily done in this as in the old style bottle. The remainder of the process is conducted exactly the same as for testing milk previously given.

If the above directions are followed, a perfectly clear separation will be obtained and also a considerable saving of time over the old method, as only one pouring of the acid and one whirling of the machine are made.

Weighing Cream for the Test Instead of Measuring.

Cream containing twenty-five per cent. of fat or less when sweet and not frothing can be measured with sufficient accuracy to give good results. But when such cream becomes sour it is impossible to get it in condition to measure without a good deal of trouble. If it is simply broken up by shaking, as is often done, it will contain so many air bubbles that the cream drawn into the pipette will weigh less than 18 grams. To illustrate what a difference there is the writer made several tests of sweet cream, then the same samples were allowed to stand in the jars until sour, broken up by simply shaking and tests made by both weighing and measuring out the samples.

	Sweet Cream measured.	Sour Cream measured.	Sour Cream weighed.
No. 1	17¼ %	14½ %	17¼ %
No. 2	18	16	18¼
No. 3	20½	18½	20½

Thick separator cream, which will always contain air bubbles if stirred enough to get a good sample, cannot be accurately measured and must be weighed to get a reliable result; and the writer has become thoroughly convinced that it is necessary for every creamery to have some means at hand to test such cream accurately. For this purpose the Station is having a special weighing scale made with which one can weigh nearly as rapidly as he can measure with a pipette. When completed it will be on sale by dealers in testing apparatus.

Precautions.

That good results and clear separations can be obtained by the previously described modifications the writer and others connected with the College have fully demonstrated. It is necessary, however, that certain details be strictly observed to attain success and to make those points more prominent they are repeated as precautions.

1st. *The acid must be of the proper strength;*—1.82 specific gravity at 60 degrees Fahrenheit is more universally successful than a stronger acid, 1.825 may be used in some cases. With very rich milk 20 to 21 c.c. of acid of 1.82 specific gravity works much better than a smaller quantity of stronger acid, probably because there is less water in rich milk to properly dilute the acid than in poor milk. Rather thin milk will give good results with acid of quite varying strength. If the acid is too strong the fat will be blackened or black particles will appear in the lower part of the fat column. If the acid is not strong enough the fat will appear cloudy and white particles of curd will collect at the lower part of the column so that an accurate reading cannot be made.

2nd. *The milk or cream should not be colder than 70° Fahrenheit or warmer than 80° Fahrenheit when the acid is added.* If the milk or cream is too cold the curd will not all be dissolved in the time allowed, and the fat will appear cloudy with white particles in the lower part of the column which will interfere with the reading. If the milk or cream is too warm the action of the acid will be too violent, the fat will be burned and the whole column appear blackened or if only slightly burned black particles will appear in the lower part of the column.

3rd. *The acid and milk or cream must be thoroughly mixed together and the mixture stand not less than five minutes before hot water is added; otherwise a clear separation will not be obtained.* It is also best to shake the bottle again slightly, just before adding the hot water, to dissolve any particles of curd that have risen with the fat.

4th. *The bottles must be whirled and heat applied as directed or the separation is liable to be incomplete.* Sometimes a cloudy fat can be cleared by heat and longer whirling.